DaimlerChrysler AG

Patent claims

1. A method for regulating an air conditioning unit for a vehicle with closeable openings in the bodywork, in particular with a convertible top which can be opened and closed, wherein a passenger compartment of the vehicle can be supplied with a controllable temperature by means of an airstream which is fed via the air conditioning system, and the air conditioning system controls the temperature of the airstream when the convertible top is closed in such a way that a deviation of an actual interior temperature of the passenger compartment determined by means of an interior temperature sensor from a predefinable setpoint interior temperature assumes a minimum value, and a state of an opened opening in the bodywork of the vehicle is sensed by means of a switching device included in the air conditioning system, characterized by the following steps

a state of an opening in the bodywork is sensed (step S0),

when the opening in the bodywork is in a closed state, an air conditioning regulating process is carried out using the parameters of ambient temperature, setpoint interior temperature, actual interior temperature and solar radiation and,

when the opening in the bodywork is in an opened state, air conditioning is carried out by regulating a blowing out temperature, an air mass flow rate and if appropriate a blowing out direction as a function of the parameters of solar radiation, ambient temperature and speed of the vehicle.

2. The method for regulating an air conditioning system as claimed in claim 1, characterized in that, if an opened state of the opening in the bodywork has been

sensed in step S0 and a blowing out temperature and/or air mass flow rate has still not been determined by the method, a constant predefined air mass flow rate M_N and a blowing out temperature θ_{AN} which is predetermined in accordance with a preselected setpoint temperature are used as first values for each of which a standard solar radiation value, a standard ambient temperature and a standard speed are predefined.

3. The method for regulating an air conditioning system as claimed in claim 1 or 2, characterized by the following steps:
if an opened state of the opening in the bodywork has been sensed in step S0,
(step Q1) the solar radiation is sensed and compared with a previously sensed solar radiation value or the standard solar radiation value if a solar radiation value has still not been sensed,
(step Q2) if a rise in the solar radiation value is sensed during the comparison, the blowing out temperature is reduced by a first value θ_{Aq1} and the air mass flow rate is kept constant or (steps Q3, Q4) the air mass flow rate is additionally increased by a first value M_{q1} if the change in the blowing out temperature alone is not sufficient, or
(step Q5) if a drop in the solar radiation value is sensed during the comparison, the blowing out temperature is increased by a second value θ_{Aq2} and the air mass flow rate is kept constant, or (steps Q6, Q7) the air mass flow rate is additionally increased by a second value M_{q2} if the change in the blowing out temperature alone is not sufficient,
(step T1) the ambient temperature is sensed and compared with a previously sensed ambient temperature or the standard ambient temperature if an ambient temperature has not yet been sensed,
(step T2) if a rise in the ambient temperature is sensed during the comparison, the blowing out

temperature is reduced by a first value $\theta_{A\theta 1}$ and the air mass flow rate is kept constant, or (steps T3, T4) the air mass flow rate is additionally increased by a first value $M_{\theta 1}$ if the change in the blowing out temperature alone is not sufficient, or

(step T5) if a drop in the ambient temperature is sensed during the comparison, the blowing out temperature is increased by a second value $\theta_{A\theta 1}$ and the air mass flow rate is kept constant, or (steps T6, T7) the air mass flow rate is additionally increased by a second value $M_{\theta 2}$ if the change in the blowing out temperature alone is not sufficient,

it is determined whether a heating regulating process or a cooling regulating process is occurring,

in the heating regulating process,

(step V1-H) the speed of the vehicle is sensed and compared with a previously sensed speed of the vehicle or the standard speed of the vehicle if a speed of the vehicle has not yet been sensed,

(steps V2-H to V4-H) if a rise in the speed of the vehicle is sensed during the comparison, the blowing out temperature is increased by a first value θ_{Av1} and/or the air mass flow rate is increased by a first value M_{v1}, or

(steps V5-H to V7-H) if a drop in the speed of the vehicle is sensed during the comparison, the blowing out temperature is reduced by a second value θ_{Av2} and/or the air mass flow rate is reduced by a second value M_{v2},

in the cooling regulating process,

(step V1-H) the speed of the vehicle is sensed and compared with a previously sensed speed of the vehicle or the standard speed of the vehicle if a speed of the vehicle has not yet been sensed,

(steps V2-K to V4-K) if a rise in the speed of the vehicle is sensed during the comparison, the blowing out temperature is increased by a third value θ_{Av3} and/or the air mass flow rate is reduced by a third value M_{v3}, or

(steps V5-K to V7-K) if a drop in the speed of the vehicle is sensed during the comparison, the blowing out temperature is reduced by a fourth value θ_{Av4} and/or the air mass flow rate is increased by a fourth value M_{v4}.

4. The method for regulating an air conditioning system as claimed in claim 3, characterized in that the step of determining whether a heating regulating process or a cooling process is occurring already takes place at the start of the sequence and
if it is determined that a heating regulating process is occurring,
in step Q2 the air mass flow rate is reduced by a value M_{q1}, and the blowing out temperature θ_A is kept constant, and/or in step T2 the air mass flow rate is reduced by a value $M_{\theta 1}$ and the blowing out temperature θ_A is kept constant, and
if it is determined that a cooling regulating process is occurring,
in step Q5 the air mass flow rate is reduced by a value M_{q2}, and the blowing out temperature θ_A is kept constant, and/or in step T5 the air mass flow rate is reduced by a value $M_{\theta 2}$ and the blowing out temperature θ_A is kept constant.

5. The method for regulating an air conditioning system as claimed in claim 3 or 4, characterized by the further step
(step S8) a change value for the blowing out temperature and a change value for the air mass flow rate are formed from the values θ_{Aq1}, θ_{Aq2}, $\theta_{A\theta 1}$, $\theta_{A\theta 2}$, θ_{Av1} - θ_{Av4} and M_{q1}, M_{q2}, $M_{\theta 1}$, $M_{\theta 2}$, M_{v1} - M_{v4}, with the values for the increase being added and the values for the reduction being subtracted and the blowing out temperature and the air mass flow rate being regulated in accordance with the change value which is obtained for the blowing out temperature and the change value

which is obtained for the air mass flowrate.

6. The method for regulating an air conditioning system as claimed in claim 5, characterized in that in step 8 a vehicle-occupant-dependent, adjustable correction value is also taken into account in the formation of the change value for the blowing out temperature and the change value for the air mass flow rate, which correction value can contribute to the change values in an additive or subtractive fashion.

7. The method for regulating an air conditioning system as claimed in claim 6, characterized in that the correction value can be adjusted manually or can be defined by adaptive operator control in response to subsequent adjustment by the user.

8. The method for regulating an air conditioning system as claimed in one of claims 3 to 7, characterized in that the values θ_{Aq1}, θ_{Aq2}, $\theta_{A\theta1}$, $\theta_{A\theta2}$, $\theta_{Av1} - \theta_{Av4}$ and M_{q1}, M_{q2}, $M_{\theta1}$, $M_{\theta2}$, $M_{v1} - M_{v4}$ are vehicle-dependent and are obtained from profile curves determined by means of measurements on the vehicle.

9. The method for regulating an air conditioning system as claimed in claim 8, characterized in that the profile curves are used only between predefined lower and upper threshold values for the solar radiation, ambient temperature and the speed of the vehicle, and for values below the lower threshold value the change value which is assigned to the lower threshold value is always used, and for values above the upper threshold value the change value which is assigned to the upper threshold value is always used.

10. The method for regulating an air conditioning system as claimed in claim 9, characterized in that 200 W and 1 000 W are used as threshold values for the

solar radiation, 5°C and 30°C are used as threshold values for the ambient temperature, and 20 km/h and 80 km/h are used as threshold values for the speed of the vehicle.

11. The method for regulating an air conditioning system as claimed in one of claims 3 to 10, characterized in that the steps Q1 to Q4 and Q1, Q5 to Q7, the steps T1 to T4 and T1, T5 to T7 and the steps V1, V2-H to V4-H and V1, V5-H to V7-H and V1, V2-K to V4-K and V5-K to V7-K are carried out either in chronological succession or simultaneously.